

REMARKS

Favorable reconsideration and allowance of this application are requested.

1. Discussion of Amendments

By way of the amendment instructions above, claim 1 pending herein has been revised so as to specify that:

- (i) the stabilizer is present with each of "an antioxidant, a formaldehyde emission inhibitor, a processing stabilizer and a heat stabilizer" (that is, all stabilizers that were originally recited in Claim 1 are now required components),
- (ii) the antioxidant as originally recited in the claim 12,
- (iii) the formaldehyde emission inhibitor as originally recited in claim 15,
- (iv) the processing stabilizer as originally recited in claim 16 except that the "higher fatty acid or a derivative thereof" is required to be "a mono- or di-fatty acid having not less than 10 carbon atoms" (based on [0074]), and to specify "an ester of mono- or di-fatty acid having not less than 10 carbon atoms with an alcohol" (based on [0075]), and an acid amide of mono- or di-fatty acid having not less than 10 carbon atoms with an amine" (based on [0077]),
- (v) the heat stabilizer as one "comprising at least one member selected from the group consisting of a metal salt of an organic carboxylic acid, an alkaline or alkaline earth metal compound, a phosphine compound, a hydrotalcite, and a zeolite" (based on original Claim 17),

- (vi) the proportion of the stabilizer that is present (that is, the antioxidant, the formaldehyde emission inhibitor, the processing stabilizer and the heat stabilizer) based on original claim 18, and
- (vii) that the polyacetal resin is "a polyacetal copolymer in which the trioxane content is reduced by a treatment with an aqueous medium or an alcohol-containing aqueous medium under heating of not lower than 800C" (based on [0010] and original claim 8).

Conforming amendments were made to claims 4, 9, 10 and 11 while claims 5, 6, 8 and 12-18 were canceled as redundant.

Accordingly, following entry of this amendment, claims 1-4, 7, 9-11 and 19-37 will remain pending herein, of which claims 25-37 have been withdrawn from consideration. Accordingly favorable action on the merits of claims 1-4, 7, 9-11 and 19-24 is solicited.

Several typographical errors were also corrected in the specification.

2. Response to Restriction Requirement

Applicants hereby affirm the election of the Group I claims, including prior claims 1-24 for examination herein. The claims of Group II (i.e., claims 25-37) directed to an independent and distinct invention non-elected for prosecution herein have been retained in the subject application pending final resolution of the elected claims and to preserve possible rejoinder therewith.

3. Response to Specification Objection

The trademarks employed in the specification have been capitalized.

4. Response to 35 USC §112 Rejection

Claims 5-6 and 15 have been canceled thereby rendering moot the rejection raised under 35 USC §112, second paragraph thereagainst.

5. Response to 35 USC §103(a) Rejections

A number of rejections have been raised against the prior pending claims as allegedly unpatentable under 35 USC §103(a) based on several applied publications of record. As will become evident from the following discussion, continued rejection of the claims pending herein on the basis of such publications would be inappropriate.

5.1. The Cited References

5.1.a Yamamoto (US5844059)

Yamamoto discloses the following in claim 1 thereof:

"1. A process for preparing a polyacetal copolymer comprising:

- (a) copolymerizing a reaction mixture, which includes trioxane as a principal monomer with a cyclic ether or cyclic formal..., in the presence of... a polymerization catalyst,
- (b) continuing the copolymerization reaction according to step (a) until the remaining unreacted monomers account for 10 wt. % or less of all monomers fed into the reaction mixture to thereby obtain a reaction product mixture comprised of crude copolymer product and unreacted monomers, and thereafter
- (c) treating the resulting reaction product mixture by contacting the crude copolymer product with a gaseous

basic catalyst deactivator to deactivate the catalyst, and then subsequently without washing the crude copolymer product, (ci) forming a melt of the crude copolymer product."

Yamamoto describes that "... it is preferred that the unreacted monomers remaining after the polymerization is lower, for example,...more preferably 3% by weight or less. ... a part of the residual monomers can be removed by evaporation to control the residual monomers to a given amount" (column 4, lines 44-62).

Further, Yamamoto describes that:

"The heat-melting treatment...is carried out preferably at temperatures falling in a range of a melting point of the resulting polymer or higher and up to 250°C. ... A heat treating apparatus ... having a function to knead a molten polymer and a vent function are required the polymerization catalyst is further completely deactivated in this melt-kneading treatment, and the blended basic gas as a deactivator or its adsorption column accelerates decomposition and elimination of the unstable parts of the crude polymer and is removed from the vent part together with other volatile substances.... In order to meet this purpose, it is a matter of course to preferably reduce pressure in the vent hole for aspiration"(column 6, lines 24—46).

5.1.b Okawa (US6365704)

Okawa discloses that "With regard to the terminal group, the amount of hemiformal detected by means of a $^1\text{H-NMR}$ is preferably 0 to 4 mmol/kg or, particularly preferably, 0 to 2 mmol/kg." (column 5, lines 26—29).

5.1.c Morishita (US 5288840)

Morishita discloses that "The amount of formate groups in the copolymer of the present invention should be not more than 0.025, preferably not more than 0.020, in terms of D_{1710}/D_{1470} . When D_{1710}/D_{1470} is higher than the value, the stability, heat resistance and hot water resistance of the copolymer are deteriorated." (column 4, lines 17—22).

5.1.d Fleiseher (US5567449)

Fleiseher discloses the following in claim 1.

"1. In a process for the preparation and simultaneous end group stabilization of a polyacetal copolymer in a homogeneous phase, in which a cyclic formaldehyde oligomer is copolymerized with a cyclic acetal in the presence of an initiator in a polymerization reactor and immediately thereafter the initiator is deactivated by addition of a basic substance, which comprises a procedure in which the unstable chain ends are degraded down to 0.01% to 1% in the presence of residual monomer, the improvement according to which the product spontaneously solidifies due to evaporation of the residual monomer at the reactor outlet by letting down into a pelletizing device and the residual monomer which remains and the impurities dissolved in the

product are removed by extraction with a solvent and the product is pelletized, after drying and stabilization."

5.1.e Tanimura (US 2001/0007006)

Tanimura discloses that "[0078] To prevent lowering of the molecular weight and formation of the unstable terminal group during the polymerization, it is necessary to make concentrations of impurities containing active hydrogen such as water, methyl alcohol, formic acid, etc. in trioxane or comonomers as low as possible".

5.1.f Harashina '301 (U32003/0158301)

Harashina '301 discloses the following in claim 1.

"1. A polyacetal resin composition comprising a polyacetal resin and a glyoxyldiureide compound."

Harashina '301 describes that "[10026] The level of addition of the glyoxyldiureide compound, based on 100 parts by weight of polyacetal resin, may for example be about 0.01 to 10 parts by weight... ."

Harashina '301 describes that "[0054] The polyacetal resin composition of the present invention may be provided as a particulate composition or a fused composition (pellets etc.) ."

5.1.g Harashina '591 (US2003/0036591)

Harashina '591 discloses the following invention in claims 1 and 20.

"1. A polyacetal resin composition comprising a polyacetal resin, a hindered phenol-series compound, a weather (light)-

resistant stabilizer, and a spiro-compound having a triazine ring.

20. A polyacetal resin composition according to claim 1, which further comprises at least one member selected from a processing stabilizer and a heat stabilizer."

Harashina '591 describes that:

"[0040] In the resin composition of the present invention, the ratio or proportion of the hindered phenol-series compound is, relative to 100 parts by weight of the polyacetal resin, about 0.001 to .5 parts by weight....

[0062] The ratio or proportion of the above—mentioned processing stabilizer is, relative to 100 parts by weight of the polyacetal resin, about 0.01 to 10 parts by weight....

[0093] The ratio or proportion of the heat stabilizer can be selected within the range of about 0.001 to 10 parts by weight,..., relative to 100 parts by weight of the polyacetal resin."

5.1.h Kim (US2001/049415)

Kim discloses the following invention in claim 1.

"1. A polyoxymethylene resin composition comprising: (i) from 45 to less than 97% by weight of a polyoxymethylene resin (Component A); (ii) from 1 to less than 20% by weight of a thermoplastic polyester elastomer (Component B) (iii)

from 2 to 35% by weight of a thermoplastic polyurethane elastomer (Component C) and (iv) from 0.1 to less than 10% by weight of a maleic anhydride-grafted aliphatic polyolefinic rubbery polymer (Component D), based on the total weight of Components A, B, C and D."

Kim describes that "[0052] The inventive resin composition may further comprise one or more additional ingredients such as formaldehyde or formic acid scavengers, mold releasing agents, anti—oxidants, end—group stabilizers, fillers, colorants, reinforcing agents, light stabilizers, pigments, and the like."

5.1.i Katsumata (U55190828)

Katsumata discloses the following in claim 1.

"1. A low surface gloss polyacetal resin composition comprising (A) 100 parts by weight of a polyacetal resin; and (B) a surface gloss reducing effective amount between about 0.1 to 40 parts by weight of a silicone graft copolymer...."

5.1.j Tajima (US5854324)

Tajima discloses the following in claim 1.

"1. A polyacetal resin composition prepared by melting a polyacetal resin (A), a modified olefinic polymer (B) modified with at least one member selected from the group consisting of an unsaturated carboxylic acid and an acid anhydride thereof, and their derivatives, and an alkylene glycol polymer (C) ... and kneading them each other, wherein component

(B) is contained in an amount of 1 to 100 parts by weight based on 100 parts by weight of component (A),..."

5.1.k Arnoldi (US5541284)

Arnoldi discloses the following in claim 1:

"1. A method for producing polyoxymethylene having a residual monomer content of less than 2 weight %, comprising treating crude polyoxymethylene containing residual monomer dry with a pure pressureless superheated water Vapor gaseous medium that is inert to polyoxymethylene, wherein the residual monomer is at least partially in the form of a cyclic formaldehyde derivative, and wherein the gaseous medium contains at least 10 volume % of water vapor, and less than 0.1 volume % of a volatile base, and less than 1 volume % of a volatile solvent, so that polyoxymethylene having a residual monomer content of less than 2 weight % is obtained thereby.

5.1.l Yamamoto (US5886139)

Yamamoto discloses the following in claim 1:

"1. A process for producing a polyacetal copolymer comprising the steps of: (A) copolymerizing, under polyacetal copolymerization conditions, a polymerization system comprised of trioxane monomer with a cyclic ether or a cyclic formal ... in the presence of a protonic acid polymerization catalyst... under conditions of steps (A), (B) and (C), until reaching a polymerization degree of at least

60% ..., to thereby obtain a reaction product mixture comprised of crude polyacetal copolymer, unreacted monomers and polymerization catalyst, and then subsequently (B) causing the unreacted monomers in the reaction product mixture to vaporize, and (C) separating the vaporized unreacted monomers ... to thereby reduce the remaining monomer content thereof to 5% by weight or less based on the weight of the crude polyacetal copolymer therein."

Yamamoto describes that "This invention separates and removes the unaltered monomers from the polymerization system at least until the residual content of unaltered monomers in the polymerization reaches a level of ... further preferably not more than 2% by weight, based on the amount of the polymer. Naturally, the final residual monomers are preferred to be in the smallest possible amounts because they are simply set aside as a waste." (column 7, lines 25—33)

Further, Yamamoto describes that "the crude polymer which has added the catalyst—inactivating agent may be immediately subjected to a heat treatment for dissolution. This heat treatment is preferred to be carried out in the presence of a stabilizing agent. ... The stabilizing agent to be used as an important component herein may be any of the known substances such as ... various hindered phenol type antioxidants. Advantageously, a varying nitrogen-containing compound, metal oxide, or fatty acid salt is used in combination with this stabilizing agent." (column 10, lines 33—53), and "The temperature of the heat treatment... is in the range between the melting point of the formed copolymer and 250°C.,... The device for this heat treatment... is only required to be capable of kneading the molten polymer and furnishing a vent for the entrapped gas." (column 11, lines 20—28)

5.1. Patentability of the Claimed Invention Over The Cited References

The cited references do not disclose or suggestion the combination of a polyacetal resin (polyacetal copolymer) in which the trioxane content is remarkably reduced (that is, a polyacetal copolymer having the trioxane content of not more than 100 ppm) by a specific solvent treatment (that is, a treatment with an aqueous medium or an alcohol-containing aqueous medium under heating of not lower than 80°C) and specific stabilizers (that is, the specific antioxidant, the specific formaldehyde emission inhibitor, the specific processing stabilizer and the specific heat stabilizer) in a specific proportion.

Against this viewpoint, the examiner asserts that:

"It is the Examiner's position, absent evidence to the contrary, given the disclosed broad range of 3wt% or less by Yamamoto (US'059 or US'139) (or 2wt% or less by Arnoldi) that the amount disclosed by the reference meets the presently claimed amount of 100 ppm or less".

However, such cited references do not disclose the specific solvent treatment. Thus, even though these cited references do not disclose a concrete lower limit of the trioxane content, it is clear that the polyacetal resins disclosed thereby would never reduce the trioxane content to not more than 100 ppm.

Firstly, the process for purifying or stabilizing the crude copolymer in Yamamoto is commonly used and the polyacetal resin produced by Yamamoto, for example, corresponds to "(a-5) Polyacetal copolymer [trioxane content =290mg/kg]" or "(a-6) Polyacetal copolymer [trioxane content =250mg/kg]" of the present description (page 91. lines 4-7), which corresponds to the Comparative Example in the present description.

The Examiner is therefore requested to review specifically the process of Yamamoto with the process for the "(a-5)" or "(a-6)" as described thereafter.

US '059 describes that "(a part of the polymer was sampled to determine a residual monomer amount) ***(please note that Residual monomer amount is not less than 2.0% (equal to "20000 ppm" far more than 100ppm) (based on TABLE 1))***,... (I) the pulverized polymer was contacted with the basic bas...at B0~C for 30 minutes. (II) Then, 0.5% of tetrakis—[methylene—3- (3,5-di-t-butyl-4-hydroxyphenyl)propionate] methane as a stabilizer and 0.2% of melamine were added to agitate (III) Then, the polymer was molten and kneaded at a temperature of 210°C at a vacuum degree of 5 mm Hg at the vent part ... and extruded to prepare pellets." (column 8, lines 3-15)

Further, US '139 describes that "The product extracted from the reaction device was sampled and analyzed for residual monomer content (***please note that Residual monomer amount is not less than 1.0% (equal to "10000 ppm" far more than 100ppm) (based on TABLE2)***)...(I) the reaction product ...was ...made to add a varying basic gas or basic compound solution ..., and stirred at 80°C for 30 minutes. (II) Then, the resultant mixture and 0.5% of tetrakis-4methylene-3-(3,5-di-t-butyl—4—hydroxyphenyl)propionate] methane as a stabilizer, 0.1% of melamine, and 0.03% of magnesium oxide added thereto were... mixed together.... (III) The produced blend was ... melted and mixed therein at a temperature of 210°C, and extruded under a vacuum degree of 5 mmHg in the vent part to produce pellets." (column 14, line 56 to column 15, line 6)

Incidentally the present description discloses that "(I) the polymerized product ... was charged into 1000 ppm of triethylamine aqueous solution to deactivate the ...catalyst,... (II) Further, to 100 parts by weight of the crude polyacetal copolymer was mixed 0.1 part by weight of triethylene glycol bis [3- (3-t-butyl-5-methyl—4—hydroxyphenyl) propionate] as an antioxidant.... (III) With aspirating at a resin

temperature of 210°C under vent vacuum degree of 20 Torr, an aqueous solution of triethylamine (5% by weight) was added in a proportion of 3 parts by weight per 100 parts by weight of the crude polyacetal copolymer to the biaxial extruder, and the mixture was melt-mixed to obtain a pelletized stable polyacetal copolymer (A) (E0165)]. This obtained copolymer (A) corresponds to the "(a-S)" (trioxane content =290mg/kg, [0174]). In addition, the "(a-6)" (trioxane content =250mg/kg) is also produced by a similar process to the process for the "(a-5)" ([0173] [0175]).

Like this, the process of Yamamoto can only reduce the trioxane content to at most 250 ppm. That is, even when the crude polyacetal copolymer is melt-mixed at a temperature higher than the boiling point of trioxane under reduced pressure, the trioxane content in the polyacetal copolymer is never reduced to not more than 100 ppm. In detail, since the melt-mixed polyacetal copolymer has a high viscosity, it is impossible to reduce the trioxane in the polyacetal copolymer to a remarkably low content, that is, not more than 100 ppm even by melt-mixing under reduced pressure. It should also be specifically noted that the specific solvent treatment (and the specific heat treatment) is further made to reduce the trioxane content after the process (XXI) in Examples of the present invention (Polyacetal copolymers (a-1)-(a-4), [0167]-[0174]).

On the other hand, as the process for reducing the trioxane content in the crude polyacetal copolymer, Arnoldi disclose a specific dry processing (or treatment) instead of a conventional treatment for the purpose of avoiding severe damage to the crude polymer (please see column 3, lines 8-17). That is, Arnold discloses the process for removing the trioxane from the crude polyacetal copolymer by the specific dry treatment without the conventional treatment such as a process for deactivating a polymerization catalyst, a melt-mixing process and the like. However, the process of Arnoldi, too, can never reduce the trioxane content to 100 ppm, as evidenced by the TABLE 1 of Arnoldi ***[please note that the trioxane content of "After" is not less than 0.07 wt % (equal to 700 ppm)]***

As can be seen, Yamamoto and Arnoldi do not disclose and do not indicate the polyacetal copolymer having the remarkably low trioxane content as is required in the presently claimed invention. Therefore, even if Yamamoto and Arnoldi are combined with the other references (Harashina and the like) which disclose various stabilizers, the present invention would not be the result.

According to the present invention, unexpected advantages can be obtained. That is, the polyacetal copolymer in the cited references, even if combined with various stabilizers such as an antioxidant, can not reduce the amount of trioxane elution from the polyacetal copolymer (composition) or molded product thereof, because the trioxane content of the polyacetal copolymer is not reduced to a high level (that is, to not more than 100 ppm).

On the other hand, according to the present invention, unexpectedly, not only the amount of trioxane elution but also formaldehyde emission from the polyacetal copolymer composition (or molded product thereof) can be remarkably reduced, because the specific polyacetal copolymer having the trioxane content of not more than 100 ppm is combined with the specific stabilizers in the specific proportion. These advantages are also proved by the Examples of the present description.

In view of the above, therefore, applicants suggest that the presently claimed invention could never be derived from the applied references of record. As such, withdrawal of all rejections advanced under 35 USC §103(a) is in order.

6. Response to Double Patenting Rejection

The amendments made to independent claim 1 are believed to render moot the Examienr's asserted double patenting of prior claims 1-5 based on the claims of copending USSN 11/808,124. Withdrawal of the same is also in order

HARASHINA et al
Serial No. 10/576,452
June 30, 2009

7. Fee Authorization

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140.

Respectfully submitted,

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